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ABSTRACT

Mathematics programs and mathematics teaching will change forever once a program of inclusion, that refers to more than the inclusion of handicapped students, is defined and implemented. It is apparent that mathematics has served as a filter for career and financial success. Ability grouped classes featuring pull-out programs almost universally led to tracking. A classroom in which inclusion is the rule is one in which activities are designed to challenge all learners. In New York, the State Education Department is developing its "Framework for Mathematics, Science and Technology" for elementary and secondary school mathematics. This framework and the "Addenda" series from the National Council of Teachers of Mathematics will help teachers find ways to make the curriculum and their instruction truly inclusive in terms of gender and ethnic identity. (Contains seven references.) (SLD)

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Inclusion: Why mathematics education will never be the same again

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Prepared for the NYSCEA 1994 monograph on Inclusion, on behalf of
the New York State Association of Mathematics Supervisors.

Mathematics programs and mathematics teaching will be forever different once we define and implement a program of inclusion. Often thought of as a policy regarding the placement of certain handicapped students, inclusion is so much greater than that, as to change the face of mathematics education as we have known it.

For curriculum and instructional leaders in the field of mathematics education, the challenge is clear: do we exercise our leadership in such a manner as to continue the role of mathematics as a sorter of students, or do we acknowledge the social, political and economic power of our discipline, and work for the welcoming of more and diverse students.

It is a poorly kept secret that mathematics has served as a filter for career and financial success. Despite the calls for greater access for more students, it is possible to stonewall these efforts in the name of the integrity of our subject matter. The repeated references to "all students" in such documents as the *NCTM Standards* and *A New Compact for Learning* can be so narrowly interpreted as to continue to provide some students with experiences which broaden their opportunities and others with those which narrow. In an age where educators' views of curriculum are themselves broadening to celebrate its divergent nature, mathematics educators could find themselves painted into a smaller and smaller corner by continuing to call for the teaching of a divergent course of studies to a hierarchically defined cadré of students.

Elementary Mathematics

During our "Back to Basics" phase of the 1970s and 1980s, when the arithmetic portion of a mathematics curriculum was seen as paramount, and progress through a linear set of discrete skills defined mathematics achievement, the readiness of students for school at age five, often predetermined their access to higher mathematics courses later in life. By the early identification and remediation of students who were deemed to be at risk, that risk was often realized by the nature of the attempts to ameliorate it. The ability grouped classes featuring pull-out programs almost universally led to tracking. These approaches were often seen as helpful in the short run, but seldom did students who were identified early and "properly placed" ever have the chance to escape this fate. while the motives were undoubtedly pure, the context of a skills-driven curriculum was by nature an exclusive one.

Districts looking for a means to escape from this paradigm need look no further than the *NCTM Standards*. The *Curriculum and Evaluation Standards* of 1989 set the stage for a more broadly defined course of study, one which clearly and loudly states that

mathematics is more than a collection of skills and concepts. It describes a mathematical community where important work is done and contributions by and to all of its citizens are the rule.

The *Teaching Standards*, released in 1991, give concrete examples in the form of vignettes which describe classroom settings and activities which can operationalize these standards. The overwhelming importance of the teacher and the necessity of ongoing support for the teacher, come through the Teaching Standards with great clarity. A committed and up-to-date supervisor or department chair is, in many settings, the most effective means of providing that support.

The Assessment Standards, in draft form at the time of this article's writing, also make a statement regarding the shift in curriculum and instruction. The very existence of the Assessment Standards stand as testimony to the necessity of aligning assessment with curriculum and instruction. Two standards promote the assessment of "important mathematics" and the enhancement of learning which assessment should accomplish. They stand out as most supportive of the changes put forth in the two earlier documents. The "Equity" standard, calling for "giving each student optimal opportunities to demonstrate mathematical power," is coincident with the goals of inclusion. However without demanding that we assess that which is important mathematics, in such a way as to enhance learning, the equity standard would ring hollow.

A classroom in which inclusion is the rule is one in which activities would be designed to challenge all learners. An activity would be designed in which a problem would be posed and groups of children would seek its solution. In that search for a solution, the talents of each student would be tapped. Those with greater mathematical insight would be mixed with those whose mechanical skills might outweigh their conceptual development. Students with greater graphic ability would be mixed with those detail persons necessary for any successful project. Projects which take advantage of these differences would have been both unnecessary and impossible to plan, in a classroom of the 70s or 80s. These days of skill-by-skill teaching and individual (read "solitary") learning would have provided no context for such activities.

We now know more about our subject matter and our students. Such projects are now possible and sound. They're not easy, however. The planning involved is difficult, but suggestions from such diverse sources as the draft of the Math/Science/Technology Framework from the State Education Department and the Addenda Series from the National Council of Teachers of Mathematics can help. So can a supervisory staff which remains current on research and practice and yet remains sympathetic to the very real concerns of teachers who are, in the words of the NCTM *Teaching Standards*, trying to teach in a way very different from the way they learned.

As this is being written, the draft of the State Education Department's *Framework for Mathematics, Science and Technology* is being circulated for comment. While the form of the final document is to be determined at a later date, certain exemplars are included in the draft which "help readers envision how teaching and learning on the basis of standards and the development of authentic tasks might occur in their own schools." An

elementary activity on building and testing paper airplanes would include students with a variety of interests, experiences and ability levels in a cooperative task.

An example from the *Addenda* Series can be found in the *Fourth Grade Book* in a section called "Making Sense of Data." Herein students are challenged to spend their fourth grade year making monthly notes about their growth. The activity is called "Oh, How we've changed!" and students are asked to tally and graph changes in height and foot length. Other activities which lead to graphical representations of data, which have been reached through experimentation, are also presented. The activities, the measurement, the arithmetic and the graphing are capable of being done by groups which include students of varying abilities, and varying mathematical experiences. The mix of students would not diminish the results of the activity, but might well provide some students with some cooperative activities in mathematics quite different from those they had previously experienced.

High School Mathematics

Changes at the lower levels will alter the daily routine of the high school mathematics teacher in very real ways in the not-too-distant future. However, current activity in the field may not allow practicing high school math teachers the luxury of waiting for the change to "age out" to them. Many in the mathematics community are attempting to demonstrate to our students, their parents, our colleagues and to the "village" at large, that more students can learn more and better mathematics as soon as we choose to offer it to them. The Algebra for Everyone movement can no longer be though of as a fad or a hollow platitude. The growing success stories of such projects as the *Algebra Project* and *Equity 2000* have begun to show proof that it may not just be right, it may be feasible as well. As we examine the products of our skills-driven General Mathematics courses, we find little evidence that we are producing many generals. Likewise the students in our Consumer mathematics courses would greatly enhance their roles as consumers by their avoidance of these course in favor of something more demanding.

The Addenda Series offers suggestions for planning activities for high school students, as well. *A Core Curriculum: Making Mathematics Count for Everyone* offers an inclusive course of study which, if adopted, could bring many students of varying gifts under a single umbrella. It does not necessarily suggest that all students be taught at the same pace, in the same room, but it does give suggestions for an approach quite different from that offered in most New York state High schools today.

Another book in the series, *Geometry from Multiple Perspectives*, offers an alternative approach which is meant to raise the interest level of students to the point where hard work would be the by-product. Chapter 5, "Polygons from multiple perspectives," supplies content rigorous enough for the college-bound student, in transformational geometry, yet interesting enough, with use of Escher-like Tessellations, and multicultural patterns for study of symmetry. Seeking out opportunities for curricular inclusion is one of the keys to welcoming all students to a more challenging level than had previously been expected.

As in the elementary section, the draft of the State's *Framework* provides an exemplar

of an activity which would illustrate this point at the high school level: a four week unit labeled "Producing Health Care Products." Activities such as watching commercials add a real-life aspect to an interdisciplinary project, listed at the "commencement" level, the mathematics of which includes a range of skills and concepts including estimation, calculation, interpreting and drawing inferences from statistics and related charts and tables. Assignment of tasks among students of varying achievement levels can lead to the successful completion of this project, the integration of learning of mathematics, science and technology and the potential development of more discriminating consumers.

No one suggests that simply by decreeing an end to the "dead end" courses will students who have had trouble in math suddenly acquire actuarial acumen. A support network must accompany any such attempt at inclusion of all students in more challenging mathematics. Among the suggestions one can glean from the work of the College Board's *Equity 2000* project, is that of community support. This is in the form of school-community partnerships and of parental and family involvement. The six sites which are piloting the *Equity 2000* program has succeeded in involving principals, teachers, counselors, parents and community leaders in both the planning and the implementation of their programs. They also work with nearby higher education institutions. Colleges are also engaged through the Career/Resource centers at the schools participating. Here college and career information is made available to parents and students by guidance counselors, teachers and representatives of the colleges.

On a smaller note, the schools of Cambridge, MA, as they initiated the program which has gone nationwide as *The Algebra Project*, recruited parents to host study groups in their homes as a means of supporting the students who were taking more challenging mathematics courses than those in which they might have been expected to enroll.

These support efforts, as well as the in service education of teachers and guidance counselors can serve as important "lubrication points" to ensure the smooth transition to a more inclusive approach to high school mathematics.

Conclusion

The references to the draft of the State's *Framework for Mathematics, Science and Technology* would not be complete without an acknowledgement of the Appendix which gives teachers suggestions about the integration of handicapped students into the instruction which is featured in this document. Sources of assistance to teachers for the accomplishment of this goal are listed as well "Strategies for Modifying Instructional Techniques and Materials."

As mentioned at the outset, the inclusion of which we speak is itself more inclusive than the definition regarding students who are handicapped. It speaks to all students who have not been traditionally welcomed into the mainstream of mathematics, where the "important" math is done. The history of the last 20 years have taught us an important lesson regarding the inclusion of the marginalized in our schools. It was the first third of the 1970s when the participation and achievement of girls in our secondary mathematics and science courses, when compared to that of boys, was brought to our attention as a

problem. While we are still not at parity in many areas, the differences noted between the genders has decreased significantly. The participation and achievement of other groups, mainly defined by their race or ethnicity is now being similarly called to our attention. Will there ever be a time when unlabeled disaggregated data will be impossible to categorize? Will there ever be a time when race, ethnicity, gender, handicap or socioeconomic status will not serve as an effective sorter of students for their mathematics participation or achievement? I am hopeful that there will. Between the disparate data of the 1970s and the more equitable treatment of female students today, there was a time of hope. That's where I believe we stand at the moment. However, hope alone will not achieve the goals of inclusion, only professionals with vision, believing that the hard work needed to achieve that goal, is worth the effort.

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